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Book Review: *Statistical Thermophysics*

Statistical Thermophysics. Harry S. Robertson, Prentice-Hall, New Jersey, 1993.

"One kilogram of water, initially at equilibrium at 20°C is heated to 100°C and left in an insulated container, again at equilibrium. Calculate the ratio, Ω_f/Ω_0, of the number of final microstates to initial microstates of the system." This is one of 117 problems which can be found in this new textbook. The solution is there as well, with the final result, $\exp(7.31 * 10^{25})$. This simple problem illustrates the enormous increase in the number of microstates of a macroscopic thermodynamic system as a consequence of a finite entropy increase.

This example reflects the author's choice of a title for the book. He prefers *Statistical Thermophysics* rather than *Statistical Mechanics* or *Statistical Physics*, to indicate that the subject matter is in the area of *thermal* phenomena (with temperature and entropy as key concepts) and the treatment is *statistical.*

Robertson's book is more than simply another textbook in statistical physics. It differs in several aspects. First, it gives the reader the feeling of reading a lecture rather than somewhat dry technical material, which makes it, of course, much more interesting. The scientific background, applications, and historical perspective discussed in the text, apart from a more detailed Commentary subsection at the end of each chapter, enrich the book and introduce the reader to the development of the academic battlefield of statistical physics. Second, it covers an extremely wide range of topics, yet the treatment is not superficial, but very detailed and clear. It starts from ideas of information theory, surprise, entropy, and probabilities, and the intuitive relationship of these mathematical concepts to statistical thermophysics, goes through white dwarfs, neutron stars, phase transitions, and renormalization, and finishes with stochastic processes. Third, the book addresses explicitly the long-standing controversy about the choice of the Gibbs or Boltzmann entropy, the author's preference being for the Gibbs formulation. And last but not least, the inclusion of

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solutions to all the problems introduces both applications and useful techniques for solving problems, which is extremely helpful for self-study and exercises.

The ten chapters of the book are 1. Basic Concepts, 2. Thermostatistics, 3. Equilibrium Statistical Thermophysics, 4. Noninteracting Fermions and Bosons, 5. Dielectric and Magnetic Systems, 6. Thermodynamics of Phase Transitions, 7. Systems of Interacting Particles, 8. Renormalization, 9. Irreversible Processes, and 10. Fluctuations. Most of the chapters begin at a level that should be accessible without difficulty for a graduate course, and end at a higher level of rather advanced topics, where current literature becomes relevant and frontiers of thermal physics are discussed. For example, Chapter 3, which is devoted to equilibrium statistical thermophysics, starts with basic concepts and simple applications to systems of noninteracting particles, and ends with treatments of the statistical operator and Feynman path-integral methods, which can be skipped in first reading. In addition, very useful Appendices are given on generating functions, Fermi and Bose integrals, combinatorial miscellanea, Jacobians, summation techniques, N-space, and numerical constants.

The book contains an impressive number of 516 references listed at the end of the book, where at the end of each chapter one can find the relevant principal of them (order of 10). The references cover a period of more than 120 years, starting from 1869 and going up to 1992. They include classical books and monographs by Boltzmann, Gibbs, Maxwell, Bohr, Schrödinger, and others, as well as pioneering and current research papers, and even a book review, in this journal by Parsegian, which is quoted in the context of commentary on the subject of entropy.

The format of the book is very attractive. The entire material, nicely printed using TeX, fits within a reasonable size of 582 pages. The illustrations and figures are very useful and constructive.

In summary, Robertson's book makes an excellent textbook, which undoubtedly will be kept by students for use as a reference book throughout their career.

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